

CLAIMS

1.

A stator winding method comprising:

- (a) providing a transport pallet and a winding pallet, the winding pallet removably positioned upon the transport pallet;
- (b) conveying the transport pallet with winding pallet thereon along a conveyor in a substantially horizontal first direction to an input side of a winding station;
- (c) raising the transport pallet with winding pallet thereon above the conveyor;
- (d) holding the winding pallet in place as the transport pallet is lowered so as to separate the winding pallet from the transport pallet;
- (e) laterally moving the winding pallet in the first direction and into a first pivot arm;
- (f) pivoting the winding pallet through substantially ninety degrees to a first position alongside a winding position;
- (g) laterally moving the winding pallet in the first direction out of the first pivot arm and into the winding position;
- (h) performing a winding operation at the winding position;
- (i) laterally moving the winding pallet in the first direction into a second position alongside the winding position and into a second pivot arm;
- (j) pivoting the winding pallet through substantially ninety degrees to a position above the conveyor;
- (k) laterally moving the winding pallet in the first direction out of the second pivot arm and into a pallet combining position and holding the winding pallet in the pallet combining position;
- (l) laterally moving the transport pallet along the conveyor into a position below the pallet combining position;
- (m) raising the transport pallet up into contact with the winding pallet;
- (n) releasing the winding pallet so as to rest upon the transport pallet; and

(o) lowering the transport pallet with winding pallet thereon back onto the conveyor.

2. The method of claim 1 wherein step (l) takes place during one or more of steps (e), (f), (g), (h), (i), (j) and (k).

3. The method of claim 1 wherein the movement of steps (e), (g), (i) and (k) takes place via action of respective linear actuators.

4. The method of claim 1 wherein after step (f) and prior to step (g) a position of the stator with respect to the winding pallet is set to a winding reference position.

5. The method of claim 4 wherein step (m) includes setting a position of the stator with respect to the winding pallet to a second reference position different than the winding reference position.

6. The method of claim 1 wherein the pallet holding operations of steps (d) and (k) involve the use of respective pairs of gripping arms.

7. A stator winding method comprising:

(a) providing a transport pallet and a winding pallet, the winding pallet removably positioned upon the transport pallet;

5 (b) conveying the transport pallet with winding pallet thereon to an input side of a winding station;

(c) separating the transport pallet from the winding pallet;

(d) pivoting the winding pallet into a first position alongside a winding position;

(e) laterally moving the winding pallet into the winding position;

10 (f) performing a winding operation at the winding position;

(g) laterally moving the winding pallet into a second position alongside the winding position;

(h) pivoting the winding pallet away from the second position and into a third position; and

15 (i) placing the winding pallet back onto the transport pallet.

8. The method of claim 7 wherein step (c) involves raising the transport pallet with winding pallet thereon above a conveyor and holding the winding pallet in place as the transport pallet is lowered.

9. The method of claim 7 wherein step (c) involves lifting the winding pallet off the transport pallet while the transport pallet remains on a conveyor.
10. The method of claim 7 wherein after step (c) and prior to step (d) the winding pallet is moved laterally into a first pivot arm, and wherein after step (h) and prior to step (i) the winding pallet is moved laterally out of a second pivot arm.
11. The method of claim 7 wherein after step (e) and prior to step (f) a position of the stator with respect to the winding pallet is set to a winding reference position.
12. The method of claim 11 wherein step (i) includes setting a position of the stator with respect to the winding pallet to a second reference position different than the winding reference position.
13. The method of claim 7 further comprising the step of after the winding operation contacting stator coil wires connected to retaining studs on the winding pallet so as to move the wires inward on the winding pallet.
14. The method of claim 13 wherein the contacting step occurs after step (h) and before step (i).

15. A stator winding system for conveying and winding a stator mounted on a winding pallet, the winding pallet removably positioned on a transport pallet, the system comprising:

- a conveyor;
- 5 a pallet separation station at an upstream side of a winding machine;
- an elevator below the pallet separation station, the elevator lifting the transport pallet with winding pallet thereon off the conveyor and up to the pallet separation station;
- a pair of gripping arms for moving into a holding arrangement with the
- 10 winding pallet at the pallet separation station;
- an upstream pivot arm positioned adjacent the pallet separation station for receiving the winding pallet from the pair of gripping arms and pivoting the winding pallet through substantially ninety degrees to a position upstream of a winding position of the winding machine.

16. The system of claim 15, further comprising:

a downstream pivot arm positioned for receiving the winding pallet from the winding position of the winding machine and pivoting the winding pallet through substantially ninety degrees to a position above the conveyor;

5 a pallet combining station adjacent the position above the conveyor;  
another pair of gripping arms at the pallet combining station for receiving the winding pallet from the downstream pivot arm;

10 another elevator below the pallet combining station for moving the transport pallet off the conveyor and up into engagement with the winding pallet at the pallet combining station;

the another pair of gripping arms moving out of engagement with the winding pallet when the transport pallet is moved into engagement with the winding pallet.

17. The system of claim 16 wherein the another pair of gripping arms include associated wire means for contacting stator coil wires on the winding pallet and moving them inward on the winding pallet.

18. The system of claim 15 wherein the pair of gripping arms form a pair of opposed slots for holding a plate portion of the winding pallet and the upstream pivot arm includes a pair of opposed slots for holding the plate portion of the winding pallet, the opposed slots of the upstream pivot arm aligning with the opposed slots of the gripping arms for slidably receiving the winding pallet from the gripping arms.

5 19. The system of claim 18 wherein the winding position of the winding machine includes a pair of opposed slots for holding the plate portion of the winding pallet, the opposed slots of the winding position aligning with the opposed slots of the upstream pivot arm when the upstream pivot arm rotates the winding pallet into the position upstream of the winding position.

20. The system of claim 18, further comprising:

at least a first linear actuator at the pallet separation station for moving into contact with at least a portion of the winding pallet and sliding the winding pallet into the upstream pivot arm.

21. The system of claim 20, further comprising:

at least a second linear actuator at the pallet separation station and positioned for movement beneath the stator mounted on the winding pallet prior to a lowering movement of the elevator.

22. The system of claim 21 wherein both the first linear actuator and the second linear actuator are comprised by respective pneumatic cylinders.

23. The system of claim 15 wherein the pair of gripping arms are mounted on supports adjacent the conveyor, the supports including biasing means engaging the transport pallet when raised to the pallet separation station for biasing the transport pallet away from the winding pallet when the gripping arms have gripped the winding pallet and the elevator is lowered.

24. The system of claim 16 wherein the conveyor includes spaced apart conveyor rails and the elevator is positioned below the conveyor for movement upward and between the spaced apart conveyor rails into contact with a bottom portion of the transport pallet.

25. The system of claim 16 wherein the winding pallet includes an aperture in which the stator is mounted, the winding position of the winding machine including winding shroud portions on both sides of the winding pallet when positioned thereat and a winding needle on one side of the winding pallet when positioned thereat.

26. A system for use with a stator mounted on a winding pallet, the winding pallet removably positioned on a transport pallet, the system comprising:

a conveyor for transporting the transport pallet with winding pallet thereon;

an elevator movable between a low position and a raised position above the conveyor;

a pair of gripping arms at the raised position for holding the winding pallet; and

a pivot arm pivolvable between at least first and second positions, the first position adjacent the raised position for receiving the winding pallet from the pair of gripping arms.

27. The system of claim 26 wherein the pair of gripping arms form a pair of opposed slots for holding a plate portion of the winding pallet and the pivot arm includes a pair of opposed slots for holding the plate portion of the winding pallet, the

5 ~~opposed slots of the pivot arm aligning with the opposed slots of the gripping arms~~  
when the winding pallet is at the first position for permitting a sliding operation of the winding pallet therebetween.

28. The system of claim 27, further comprising:

at least a first linear actuator positioned for moving into contact with at least a portion of the winding pallet and effecting the sliding operation of the winding pallet.

29. The system of claim 27 wherein a winding position of the winding machine includes a pair of opposed slots for holding the plate portion of the winding pallet, the second position of the winding pallet is adjacent the winding position, the opposed slots of the winding position aligning with the opposed slots of the pivot arm  
5 when the winding pallet is at the second position.

30. The system of claim 26 wherein the pivot arm is downstream of the pair of gripping arms.

31. The system of claim 26 wherein the pivot arm is upstream of the pair of gripping arms.

32. The system of claim 31 wherein the pair of gripping arms further include wire combing arms and associated pins for contacting stator coil wires of the stator and moving them inward along the winding pallet.

33. A system for use with a stator mounted on a winding pallet, the winding pallet removably positioned on a transport pallet, the system comprising:  
a conveyor for transporting the transport pallet with winding pallet thereon;

5 means for separating the winding pallet from the transport pallet; and  
means for pivoting the separated winding pallet between at least first and second positions, the second position being upstream of a winding position of a winding machine.

34. The system of claim 33 wherein the means for separating comprises an elevator for lifting the transport pallet with winding pallet thereon in combination with a pair of gripping arms for moving into a holding arrangement of the winding pallet  
while the elevator with transport pallet thereon is lowered.

35. The system of claim 33 wherein the means for separating comprises a pair of gripping arms movable vertically between a conveyor height and a raised position, the gripping arms moving into a holding arrangement with the winding pallet when at the conveyor height and raising the winding pallet off of the transport pallet.

36. The system of claim 33 wherein the means for separating comprises a pivot arm positioned for having the winding pallet move into a supported position relative to the pivot arm as the transport pallet with winding pallet thereon move along the conveyor, the pivot arm movable vertically to effect separation of the winding pallet from the transport pallet, the pivot arm further pivotably moveable to comprise the means for pivoting.

37. The system of claim 33 wherein the means for separating includes a biasing means for contacting the transport pallet and urging the transport pallet away from the winding pallet.

38. The system of claim 33 wherein the transport pallet includes opposed slots in which the winding pallet is slidably mounted, the means for separating comprising a linear actuator for sliding the winding pallet off of the transport pallet.

39. The system of claim 33 further comprising:  
means for moving the winding pallet from the second position into the winding position.

40. The system of claim 39 further comprising:  
means for moving the winding pallet from the winding position into a third position, the third position downstream and adjacent to the winding position.

means for pivoting the winding pallet from the third position into a fourth position; and

means for recombining the winding pallet with the transport pallet.

41. A stator system, comprising:

a transport pallet; and

a winding pallet formed by a plate member including an aperture having a stator mounted therein, the winding pallet removably positioned on the transport pallet, the aperture permitting access to top and bottom sides of the stator when the winding pallet is removed from the transport pallet.

42. The system of claim 41 wherein the transport pallet includes a plurality of posts and the winding pallet includes a plurality of openings shaped for receiving the posts of the transport pallet, at least two of the plurality of posts formed by a lower portion and an upper portion, the lower portion larger in size than the upper portion.

43. The system of claim 41 wherein the transport pallet includes a positioning member for contacting the stator mounted in the aperture of the winding pallet to maintain the stator at a reference position relative to the winding pallet.

44. The system of claim 41 wherein the stator mounted in the winding pallet comprises a wound stator, the winding pallet includes at least one wire retaining stud having stator coil wire held thereat with an excess portion of the stator coil wire positioned in a non-overhanging manner relative to the winding pallet.

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